The rapid and extreme growth which overruns communities leaves little time for these communities to plan effectively for that growth. . . . We are developing "spread city"—it is neither city, suburban, or rural, it is just an amorphous spread.

Robert H. Freilich, testimony, U.S. Congress, 13 May 1971

Dangerous Duplicates

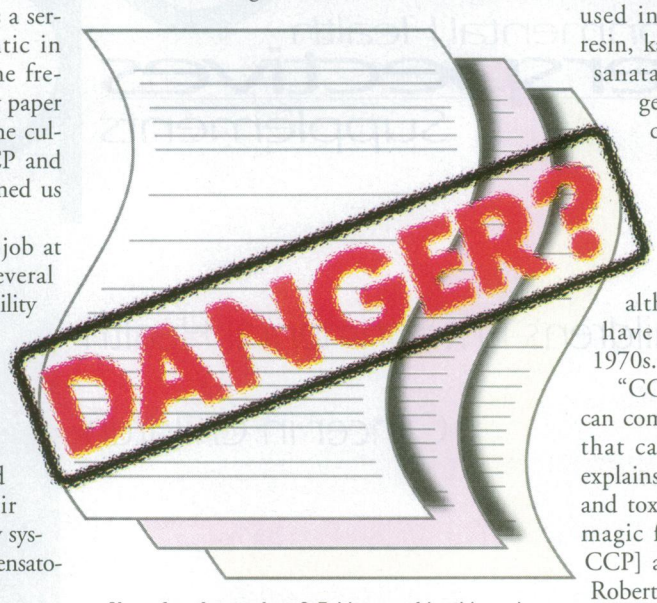
Brenda Smith's health problems, including headaches, high blood pressure, and sensitivity to perfumes, began in 1981 and have grown progressively worse during the past 17 years. Smith, 49, believes her health problems can be traced to her job as a service representative for Bell Atlantic in Virginia Beach, Virginia, where she frequently worked with carbonless copy paper (CCP). "Carbonless copy paper is the culprit," Smith says. "We handled CCP and breathed its fumes, but no one warned us about it."

Smith, who was fired from her job at Bell Atlantic in 1993, is one of several plaintiffs who have filed product liability lawsuits against the Mead Corporation, Appleton Papers, Inc., Moore Business Forms, Inc., and other CCP manufacturers. The plaintiffs, who claim they have developed formaldehyde sensitization and have suffered deterioration of their allergic, immunologic, and respiratory systems, are seeking $3 million in compensatory damages.

Introduced commercially in 1954, CCP is used to make multiple paper copies of an original document simultaneously. The paper is coated with microencapsulated droplets of colorless dyes and solvents that break when pressure is applied through writing or typing. The released dyes form an image on the backing sheet, copying the writing without the use of carbon paper.

"CCP is a pervasive presence in the workplace," says Charles Schmidt, an associate in engineering in the department of environmental engineering at the University of Florida at Gainesville, who has been studying CCP. "It's cheap and an easy way of copying mundane items like invoices, office forms, and credit card receipts."

"The number of environmental health complaints about CCP is both disappointing and frustrating," says Henricka Nagy, a toxicologist at the National Institute for Occupational Safety and Health (NIOSH). "At this point, we really can't do much about the issue because we don't have much science to explain it." Reports about adverse effects in workers exposed to CCP began appearing in the scientific literature in the late 1960s, and NIOSH has since reported symptoms anecdotally associated with its use. Symptoms attributed to exposure by touch include eczema, tingling, dryness, irritation, redness, and itchiness of the skin, while those attributed to inhalation exposure include asthma, headaches, fatigue, hoarseness, throat tickle, joint pain, nasal congestion, and respiratory tract irritation.



No safety in numbers? Evidence of health problems has prompted federal health agencies to examine the safety of carbonless copy paper.

But despite numerous studies, CCP's environmental health effects still remain a controversial issue in the scientific literature. While several researchers have concluded that some people are affected by the chemicals released in using the paper, CCP manufacturers and other scientists say past studies, including a 1987 investigation by NIOSH, have failed to find a link between CCP and worker illnesses. According to a *Federal Register* notice posted 21 February 1997, "On June 12, 1987, NIOSH published a *Federal Register* notice (52 FR 22534) requesting comments and secondary data on the toxicity of carbonless copy paper. At that time, it was determined, based on the submitted information, that insufficient data were available to conclude that the relationship between the exposure to carbonless copy paper and suggested health effects was a causal one."

No standards for recommended exposure limits exist for CCP, although there are OSHA permissible exposure limits, NIOSH recommended exposure limits, or American Conference of Environmental Hygienists threshold limit values for most of the active ingredients contained in CCP. In the past three decades, the published scientific literature has identified numerous chemicals and other substances used in CCP's manufacture, including resin, kaolin, starch, styrene, mineral oil, sanatasol oil, butadiene latex, hydrogenated terphenyls, aluminum silicate, organic dyes, diaryl ethanes, alkyl benzenes, isoparaffins, diisopropyl naphthalenes, dibutyl phthalate, aliphatic compounds, and aromatic compounds such as alkyl substituted biphenyls, although polychlorinated biphenyls have not been used since the early 1970s.

"CCP is a complex issue because we can compile a list of 1,000-plus chemicals that can be used in its manufacture," explains Rick Niemeier, a senior scientist and toxicologist at NIOSH. "There is no magic formula [for the manufacture of CCP] and it's all proprietary." However, Robert Tardiff, president of the Bethesda, Maryland-based Sapphire Group, a scientific research firm that deals with risk management issues, asserts that "several dozen compounds, certainly less than 100, are used in the manufacture of CCP coatings used in the United States."

Schmidt says his CCP study (not yet published) revealed that potentially dangerous chemicals are being used to make CCP, and that these chemicals can escape into the air as well as penetrate the skin. Schmidt found that biphenyl oil, one of the substances found in the microcapsules, flows out when the tiny bubbles are broken, either when the paper is handled or when a person writes on the top sheet. Moreover, further tests indicated that the biphenyl oil can be absorbed through the skin and could possibly help further the penetration of other compounds, such as formaldehyde, dye cursors, and hydrocarbon solvents. Schmidt says, however, "I can't really say whether CCP is causing environmental health problems. . . . It would be up to a toxicologist to take my findings and make a determination."

In the summer of 1997, the Mead Corporation, a major CCP manufacturer, asked Tardiff to review the scientific literature on their product. Tardiff spent four

months doing the study. "Mead asked me to provide a dispassionate third-party analysis," Tardiff explains. "All of the available data I examined indicate that CCP, as [it] currently is being used, is unlikely to have injurious consequences for humans."

The studies of both Tardiff and Schmidt now form part of more than 14,000 pages of scientific literature relating to CCP that are currently being studied by a task force headed by Niemeier. In February 1997, NIOSH posted a notice in the *Federal Register* requesting comments on the possible adverse health effects of working with CCP. The task force started the review in September 1997 and expected to take six months to complete its charge, but Niemeier reveals, "It's going to take longer because the docket has been flooded with information."

As for the health problems of Smith and the other plaintiffs who have filed CCP law suits, Niemeier says, "I suspect that they may be a little more sensitive than the general population, but the problem is that many of the symptoms said to be associated with exposure to CCP are very similar, if not identical, to indoor air quality problems. Is it an issue of CCP, indoor air quality, or multiple chemical sensitivity? I honestly can't say at this point."

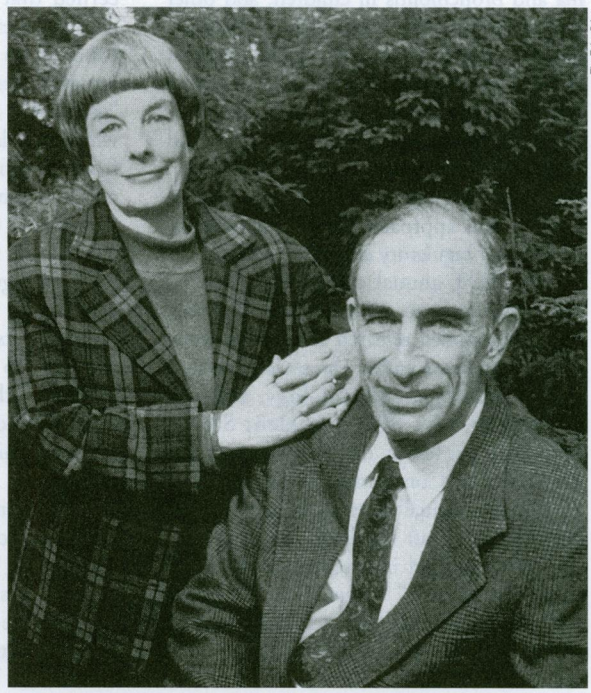
A Winning Partnership

Since 1973, the Tyler Prize for Environmental Achievement has honored significant scientific achievements by international scientists in all disciplines of environmental study and protection. At a time when concern over environmental degradation was only just beginning, John and Alice Tyler established the prize in hopes that it would inspire people across the world to understand the importance of protecting the environment.

The 1998 Tyler Prize has been awarded to Anne H. Ehrlich and Paul R. Ehrlich, both of Stanford University in California, for their individual and joint work on elucidating and publicizing the relationships between population size, resource consumption, socioeconomic equity, and the environment. The Ehrlichs were also cited for their contributions toward heightening public awareness of issues such as the environmental effects of nuclear war, toxic and radioactive waste, and pesticide pollution in agriculture. The award, presented on 17 April 1998 in Los Angeles, California, consists of a shared cash prize of $200,000 and a gold medallion for each winner.

Paul Ehrlich's early studies on butterfly populations led to the development (with environmental scientist Peter Raven) of the concept of coevolution—a process of interdependent, reciprocal evolutionary events among plants and animals that are ecologically entwined—and a theory of population regulation among animals, which the Ehrlichs extrapolated to humans, thereby helping to assess the impact of human populations on the environment. "By taking their findings into the public realm and the political arena, [the Ehrlichs] have influenced more than a generation of scientists and policy makers as well as helped shape public opinion about the environmental impact of overpopulation," says Robert P. Sullivan, chair of the committee that selects the prize winners.

Anne Ehrlich, a senior research associate in Stanford's biological sciences department and associate director of the university's Center for Conservation Biology, has taught a course on environmental policy since 1981. She currently serves as a member of the boards of directors for the Pacific Institute for Studies in Development, Environment, and Security in Oakland, California; the Rocky Mountain Biological Laboratory in Crested Butte, Colorado; the Ploughshares Fund, based in San Francisco, California; and the Sierra Club, also based in San Francisco. In addition, Ehrlich serves on advisory boards for several organizations. She is a fellow of the American Academy of Arts and Sciences, and received an honorary doctorate degree from West Virginia's Bethany College in 1990.



The Tyler Prize

Environmental achievers. Anne H. Ehrlich and Paul R. Ehrlich are the recipients of the 1998 Tyler Prize for Environmental Achievement.

Paul Ehrlich is the Bing professor of population studies and a professor of biological sciences at Stanford. He is a fellow of the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the American Philosophical Society, and a member of the National Academy of Sciences. His Stanford laboratory is currently working in several areas, including the dynamics and genetics of natural populations of *Euphydryas* butterflies, avian communities (especially in agricultural landscapes), and populations of various endangered organisms, as well as policy research on endangered species and the preservation of genetic resources as they relate to human populations and the environment.

Together, the couple have authored over 30 books, including 1968's *The Population Bomb*, which predicted the worldwide effects of overpopulation and called for developed nations to set a global example by curbing family sizes. The 1990 follow-up book, *The Population Explosion*, examined the consequences of human population growth over the intervening 22 years. Currently, the Ehrlichs are working on a series of newsletters, titled *Ecofables: Ecoscience*, that address myths about humanity's relationship to the environment using scientific facts. Together, the Ehrlichs have shared several honors, including the 1994 United Nations Environment Programme's Sasakawa Environment Prize, the 1995 Heinz Award for Environmental Achievement, and the 1996 Distinguished Peace Leader Award, given by the Nuclear Age Peace Foundation.

Science in Seattle

As mandated by the Food Quality Protection Act of 1996, the U.S. EPA is working to develop and implement a testing program to identify the potential for pesticides and other chemicals to alter the function of estrogen and other hormones. The EPA is scheduled to present a screening program to Congress in August 1998, with the program to be implemented in August 1999. The Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC) was formed to advise the EPA on a testing program. Representatives of